

## METHOD AND SYSTEM OF PRODUCTION OF SPRINGS FROM WIRE OF CIRCULAR OR OTHER CROSS-SECTIONAL AREA

### TECHNICAL SCOPE OF THE INVENTION

5       The present invention refers to a method and a system of production of springs of wire of circular or other cross-sectional area, that are produced not directly from raw wire but after first producing cylindrical springs with a diameter smaller or equal to the smallest diameter and have pitch smaller or equal to the smallest pitch of the desired finalized  
10      spring.

### STATE OF THE ART

15      The springs are produced in many ways that are all without exception based on the following method: for bending the spring at least three points (a, b, c) are required on which the wire has to be pressed in order to be bent. The two outer points (a & c) push the wire in the same direction and the middle one (b) in an opposite direction (Figure 1). If the spring is advanced from one side so as to go through these three points, then the result is to have production of circular springs (9). The spring turns always tend to be  
20      produced tangent to one another with about zero pitch advance. If though we compress the produced spring turn at a fourth point after production in a direction normal to its plane, then analogous pitch is generated.

25      The state of the art as well as the details of the method and the system according to the present invention will become understood from the description of a specific embodiment, in the sense of a non-restrictive example and by the attached figures:

30      Figure 1: Depicts conceptually the method of production of springs according to the state of the art.

35      Figure 2: Depicts a system that satisfies the kinematic demands of the method according to the positions and the way of motion of its individual components during the production phase of the initial spring.

40      Figure 3: Depicts a system that meets the kinematic requirements of the method according to the positions and the way of motion of the individual components during the production phase of the final spring.

Figure 4: Depicts a side view section of an initial spring when it is being formed of constant diameter and small pitch.

## REVELATION OF THE INVENTION

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With our method each spring is produced in two stages. First, the spring is produced (6) that is cylindrical of constant diameter and small pitch. The spring can leave a minimal zero pitch (8). The initial spring (6) does not acquire many spring turns because from its inception we utilize it to form the final spring (7) that has the desired 10 spring turn diameters and pitches.

The initial spring (6) is produced as follows: the wire is wrapped around a central roller (1) of selected diameter that has a revolving motion. The wire is compressed by one or multiple rollers (2), (3), (4) onto the perimeter of the central roller (1). The rollers (2), 15 (3), (4) can have motion. Thus, there exists a strong pulling force, acting on the wire that is reinforced by the wrapping of the wire.

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With the revolution of the central roller (1) and with the compression of the other rollers the wire is wrapped around it and thus the spring is produced. This initial spring (6) is formed such as to have a diameter smaller or equal to the smallest of the diameters that 25 we desire to impart to the final spring (7).

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It is produced easily because the wire is easily pulled through by the revolving roller (1) onto which a frictional resistance force is generated, in contrast to other methods of spring production, where the spring is being advanced compressed only at points, held in by roller pairs.

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Our innovation rests on the following: When the first spring turn of the initial spring (6) is emerging, then we compress it with a suitably formed pin (5) that encompasses it and pulls it in a direction from its centre towards the outside. Thus the spring turn is forced to enlarge and to bend acquiring the controlled desired diameter. In the same way the same spring turn is compressed in the longitudinal direction of the spring in the sense of the spring turn advance. In this fashion it bends creating a regulated pitch. The effecting force in the spring turn advance direction can also be generated with the same pin 35 (5) that creates the diameter or from a second other suitably formed pin. There is a difference with the till recently existing methods. With these methods the rectilinear wire

passing through the rollers is compressed to enter through three point mechanisms so as to be bent and thus with the continuous advance to form the spring turn and the desired diameter. The pressure exerted to transform the straight wire to a circle is accomplished from the outer direction towards the inner one. In our method, the pressure exerted to create the diameters is accomplished in a totally different fashion from the inner direction towards the outer one because we have to form not the wire, that has first been straightened, but an already prepared cylindrical spring whose existing diameter and pitch we would like to enlarge.

10 When with continuous advancement of new spring turns and consecutive movements of the pins (5) the desired final spring (7) is formed with the desired diameter and pitches then with a suitable severing mechanism the spring is cut to the desired point and then again commences the production of the subsequent spring. In the regulation for the production of the initial springs (6) the diameter of the wire is taken into consideration as

15 well as the smallest diameter that the final spring (7) will have, so as to select the proper diameter of the central revolving roller (1) so as to form the analogous initial cylindrical spring (6). Around the central roller (1) it is not necessary to wrap many spring turns, since already with the turning of the wire onto a portion only of the circumference, the bending corresponding to the diameter of the initial spring (6) has been achieved.

20 It is possible for the central roller (1) to have a width of only a few millimetres or at minimum as much as the diameter of the processed wire. The formed spring turns are exiting axially from the roller (1) being pushed by each newly produced spring turn.

25 The cylindrical spring can also be accomplished by a fewer 180° turning of the wire around the roller (1). In such a case, the start of the first spring turn that leaves its encapsulation between the central roller (1) and the final roller (3) that compresses it, is ready to accept its further formation in order to develop the desired final diameter and to impart the final desired pitch.

30 When the first spring turn emerges it has, due to rigidity, a diameter larger than that of the central roller (1) onto which it has been wrapped around and thus there is room in order for the pin (5) to come underneath it, that comes into the space between the spring turn and the central roller (1), contacting it at the interior.

With this pin (5) we achieve a pushing effect of the spring turn towards the outside so as to form its diameter, but as well as the advancement of the spring turn towards the longitudinal direction of the spring, so as to form the pitch. The source of motion of the pin (5) to form the diameter and spring turn pitch can be situated on an axle (10) that is 5 suitably situated on a base (11).

From the axle (10) via an elbow member (12) onto one end of which the properly shaped pin (5) is attached, we reach from beneath at the interior space of the formed spring turn so that the pin (5) in contact at its inner side of it, encapsulates it.

10 Thus, when we revolve the axle (10), then the pin (5) that has encapsulated the spring turn pushes it towards the spring forming direction producing thus the diameter. Thus, with the same axle (10) combining its axial and its revolving movements, we have the necessary combinations of diameters and spring turn pitch for the formation of the desired springs (7). It is possible alternatively the pin (5) that is set at the end of one elbow member (12) that in turn is connected to an axle (10) that is suitably resting upon a base (14), to effect only the pushing of the spring turn towards the outside for the creation of the spring diameter, whereas the movement of the spring turn in the direction of the longitudinal spring advance direction to create its pitch to be effected by a second 15 independent mechanical element with a pin that is resting on an elbow member, that in turn is connected to an axle, that is suitably resting on a base. This second mechanical element is not shown in the accompanying figures.

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25 Preferably, the motion of the rollers that have motion and of the axle (10) that transmits the motion through the elbow (12) to the pin (5) is directed, controlled and coordinated by a suitable electronic computer, through which we can input the proper variables and characteristics of the final spring undergoing production, which are selectively the diameter and the pitch of each spring turn, so as to direct properly the operation of the system.

30 **ADVANTAGES OF OUR METHOD**

With the usage of the initial spring (6), which is easy in its production, we achieve the following:

1. It is not necessary to have one or two sets of rollers to pull the wires from the spools and for its advancement into the processing area. The rollers, besides being expensive to manufacture, damage the wire because they compress it at a point while its revolution and its wrapping around a roller is both simple and easy to accomplish and does not harm the wire material.  
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2. The wire does not need to be straightened as in the other methods, which both are difficult to achieve and with production costs that are expensive.
- 10 3. Due to the rolling around a roller, the resistance to the pull of the wire due to the weight insertion of the material spool is met by the frictional forces of the wire around this roller.
- 15 4. The alternating resistance force value coming from heavy wire spools in the method of advancement of the wire with rollers to produce spring diameters directly from straight wire, generates problems in the quality of the product that do not exist in our method. In the existing method, special type motors are needed and control of the wire payload station. This creates additional expenses. With our method, the strong pulling force and the non-influence of various types of resistant forces in the quality of the springs solve this problem.  
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5. Due to the fact that the first constant diameter has been created in the initial spring, the subsequent spring diameters necessitate fewer frictional forces and less energy to be consumed for their production.  
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6. There is large economisation of space with the abolishment of the pulling rollers of the straightening systems and the revolution control mechanisms of the wire payload stations. Additionally our method is most suitable for the production of multi-head mechanical complexes.  
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A system that consists of a special embodiment of the described method is depicted in Figure 3.

The present invention is not restricted by any means in the depicted embodiment that is described and presented in the figures as an example, but can be accomplished in many forms and dimensions without deviation from the protection rights  
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granted to this invention. In the embodiment of the invention, the materials utilized as well as the dimensions of the individual mechanical components can be adapted to the needs of the individual construction design.

5 In each claim where technical characteristics are presented and are followed by references, those are included only to enhance the understanding of the claim and in this fashion the references do not influence the review of the elements that are recognized through these in the example.